Spatiotemporal analysis of neuromagnetic responses to faces presented in an oddball paradigm

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Introduction

Faces are very important stimuli in social interactions. By seeing someone's face we can recognize an individual, his/her age, gender, and emotional state which determine our reaction to that person. Detection of a change in face stimulus is an essential social skill.

A great number of behavioral and neuroimaging studies have used different experimental paradigms to investigate face processing [*e.g.*, 1]. We used event-related potentials (ERP) and magnetoencephalography (MEG) to examine brain activity during the presentation of happy and neutral faces in an oddball paradigm. In a previous study [2], we found a negative ERP deflection and the corresponding response in MEG to deviants with a maximum around 280 ms. The aim of the present study was to find neural substrates of this effect.

Methods

Five male subjects (age 22-28 years) with normal or corrected vision participated in the study.

Gray-scale face stimuli subtended a 2.7º x 2º visual angle and were presented at the center of the visual field for a duration of 150 ms with an interstimulus interval of 450 ms. Faces were presented in an oddball paradigm in two conditions: 1) neutral face deviant (P = 0.13) and happy face standard (P = 0.75); 2) same neutral face deviant as in condition 1 and neutral face standard (Figure 1). The task in both conditions was silent counting of the target stimulus (face with glasses, P = 0.12). 150 neutral face deviants were presented in each condition.

MEG data were recorded with a 306-channel whole-head system (Vectorview, Elekta Neuromag, Helsinki, Finland) in a magnetically shielded room (Euroshield Ltd., Eura, Finland) simultaneously with a 60-channel MEG-compatible electrode cap at the BioMag Laboratory, Helsinki University Central Hospital.

Spatio-temporal analysis was carried out with BESA (MEGIS Software, Gräfelfing, Germany) assuming a multiple-current-dipole model in a spherical volume conductor.

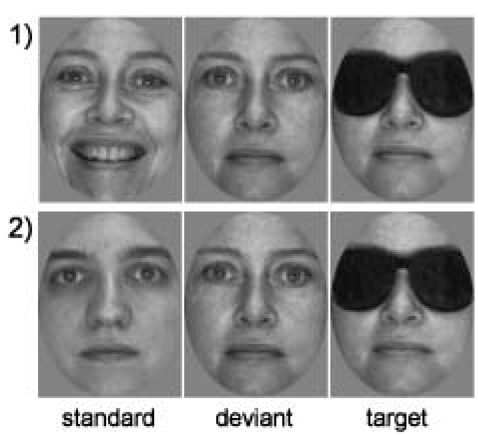

Figure 1. Face stimuli in two conditions.

Results

Our preliminary results showed that the difference between responses to standards and deviants reflected modulation of extrastriate activity. For three out of five subjects locations of current dipoles did not differ considerably for standards and deviants while their dynamics were distinct (e.g., dipole 2 in Fig. 2). We did not identify any clear difference in locations of current dipoles for standards and deviants between the two conditions.

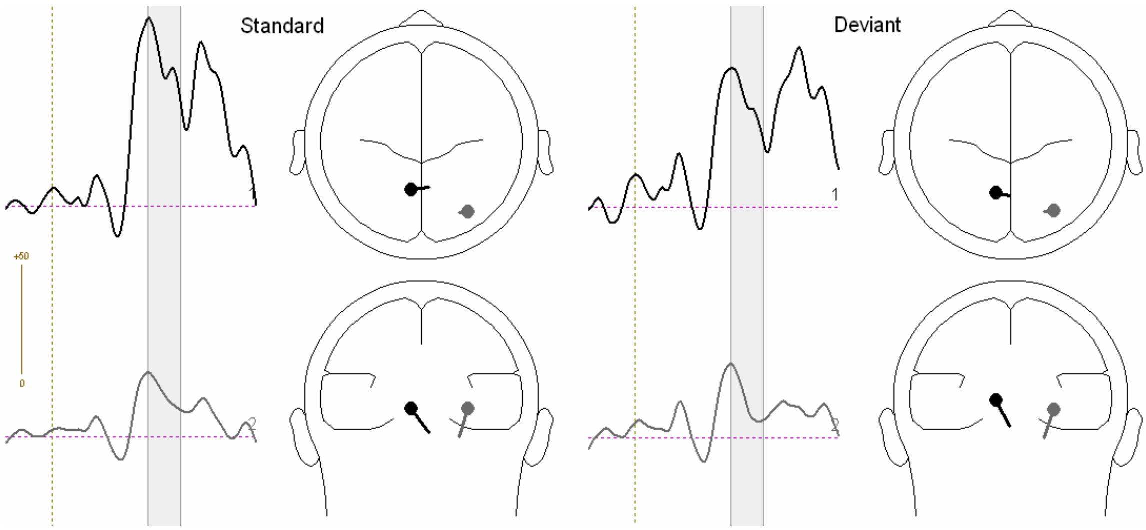

Figure 2. Locations of best-fitting current dipoles and their time courses in the time window 210-280 ms post-stimulus for subject S1 for happy standard face and neutral deviant face (condition 1).

Discussion

Neural substrates of an MMN-like negative deflection in MEG responses (200-300 ms) were identified in extrastriatre regions around the fusiform gyrus. A number of studies have already reported activation of fusiform gyrus during face processing [*e.g.*, 1], however, mostly about 170 ms. This study suggests that negativity in a difference waveforms deviant-standard could have been generated by the time course modulations of the active regions evoked by standard and deviant stimuli. The effect was more pronounced in the right hemisphere (dipole 2 in Fig. 2). Such a finding is in agreement with previous studies that reported right hemisphere dominance in face processing [*e.g.*, 1].

References

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